Drinking Water Source Protection Conference

New Hampshire Department of Environmental Services and American Ground Water Trust

Surface Water Afternoon Session

May 11, 2016

Water Supply Protection In Pennichuck Brook Watershed

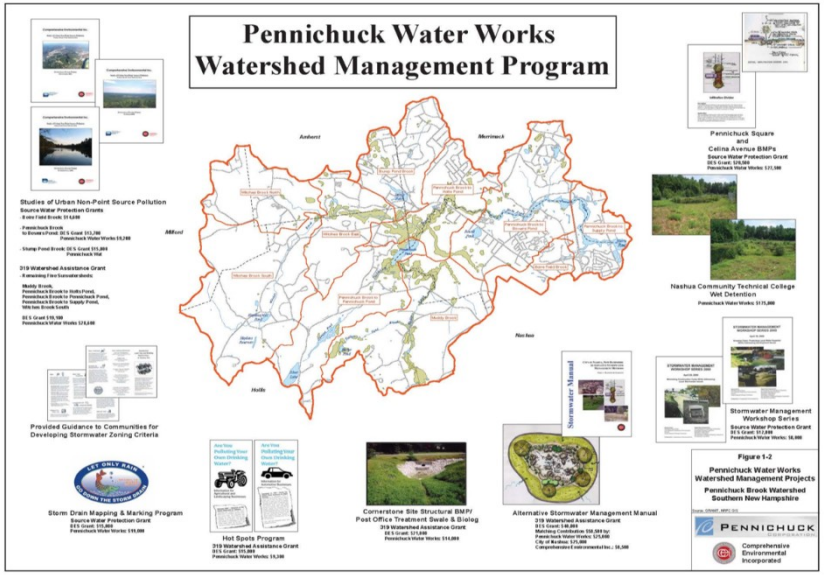
Pennichuck Water Works

NH Department of Environmental Services

Water Supply Protection

Question:

What does it take to protect a surface water supply?



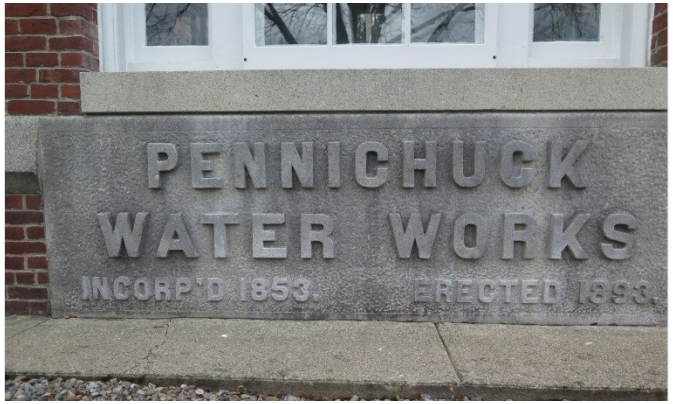
Security fencing? Spill controls?

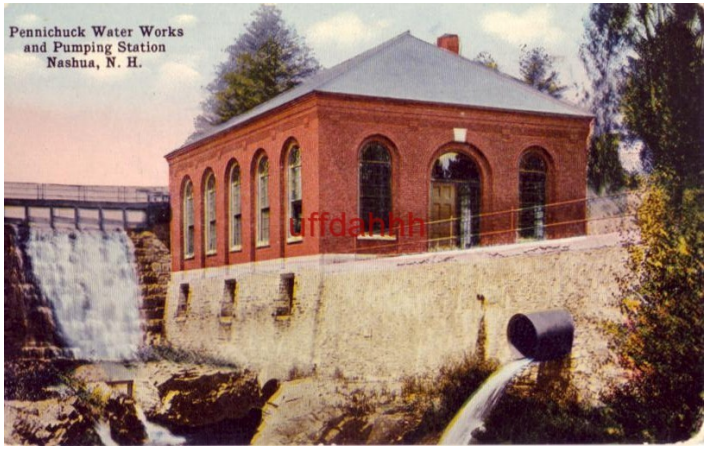
Overview

- Pennichuck Water Works & The Supply Ponds
- Watershed Description
- Watershed Management Plan
- Nutrient Modeling
- Public Outreach
- Water Quality Monitoring
- Sediment Monitoring
- BMP Implementation

Drinking Water Supply

- Pennichuck Water Works (PWW) manages drinking water for the Greater Nashua Area (Southern NH).
- Includes Nashua and several other municipalities.
- Serves an estimated population of 110,000 people.
- The supply ponds account for approx. 75% of the water supply.



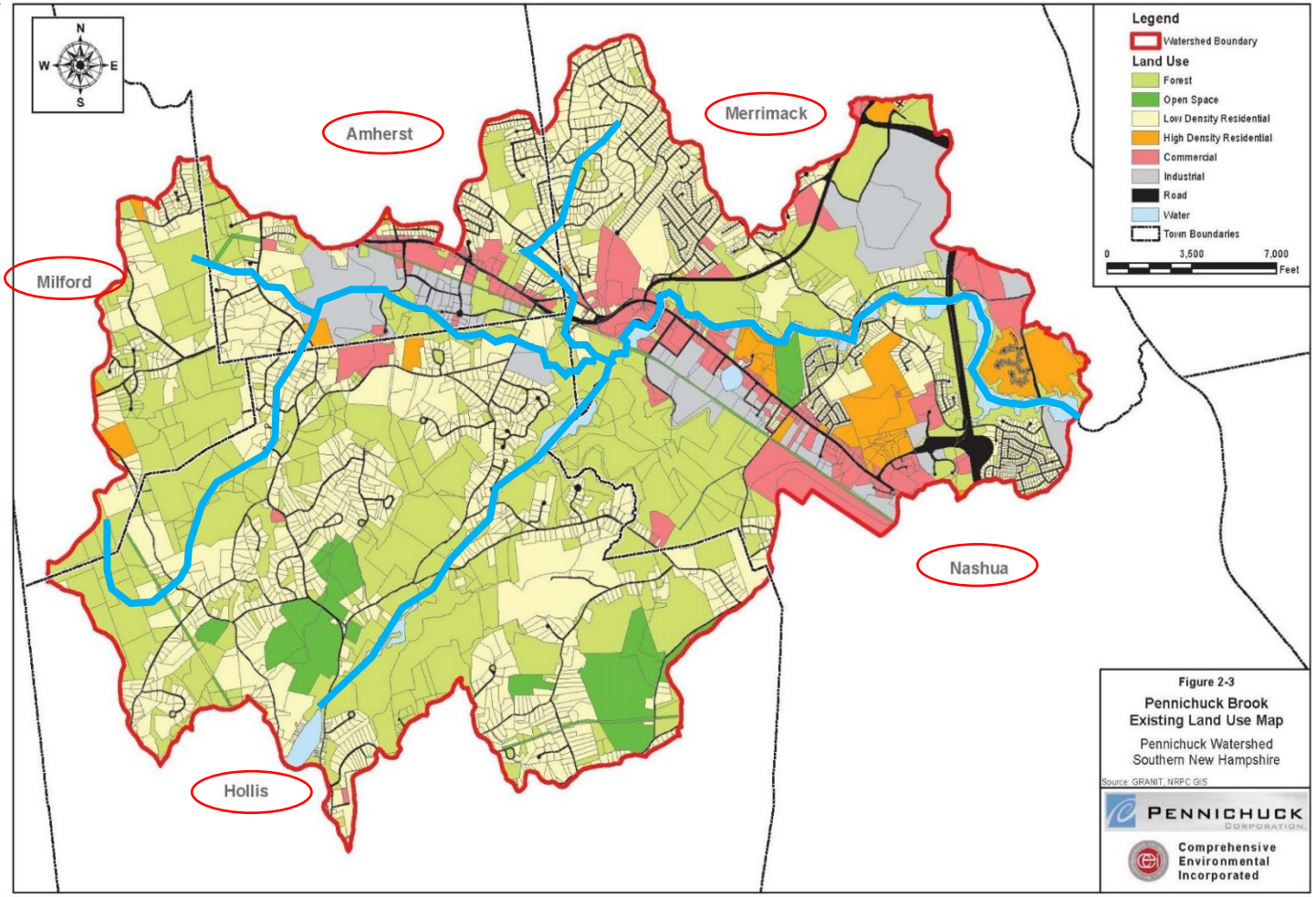


Supply Ponds

- Supply pond system is made up of 4 ponds
- 4 dams control flows through the supply pond system
- The reservoir system is approx. 195 acres in size
- The reservoir supplies an approx. average of 10 MGD

Watershed

- Pennichuck Brook & Tributaries
- Crosses 5 town boundaries
- Approx. 27.5 square miles.
- Commercial, Industrial & Residential Development associated with Route 101 corridor.
- Expansive roadway system associated with the Turnpike.

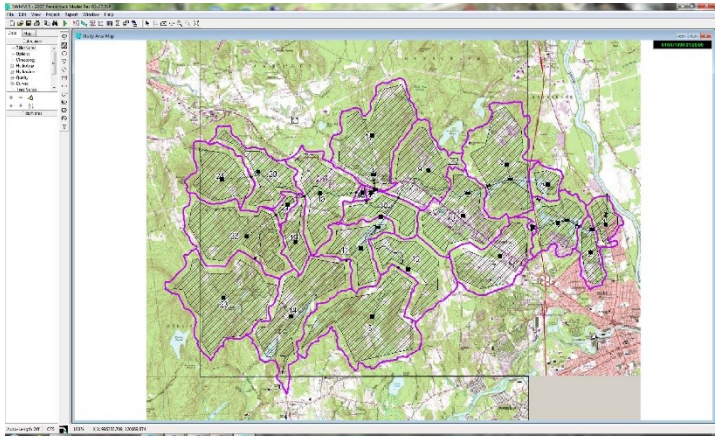


Watershed Management

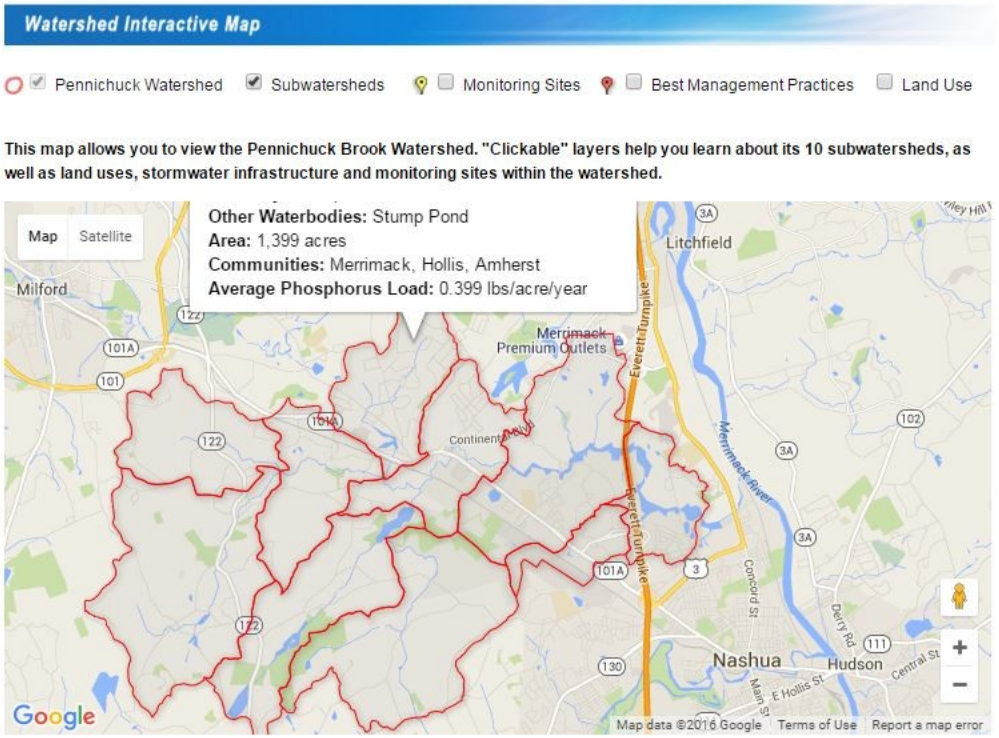
- ✓PWW originally developed a Watershed Management Plan (WMP) in 1998.
- ✓Continually monitor and update progress in the plan, including a major update in 2008.
- ✓Included a detailed nutrient modeling effort.
- ✓The extensive management plan is on-going and includes public outreach, water quality monitoring, sediment monitoring and implementation of watershed controls.
- ✓The WMP also identified highly critical locations for stormwater related issues and accidental spill potential.

Nutrient Modeling

- 10 individual subwatersheds (1,200 to 3,200 acres).
- Phosphorus loading model used for the basis of the management plan.

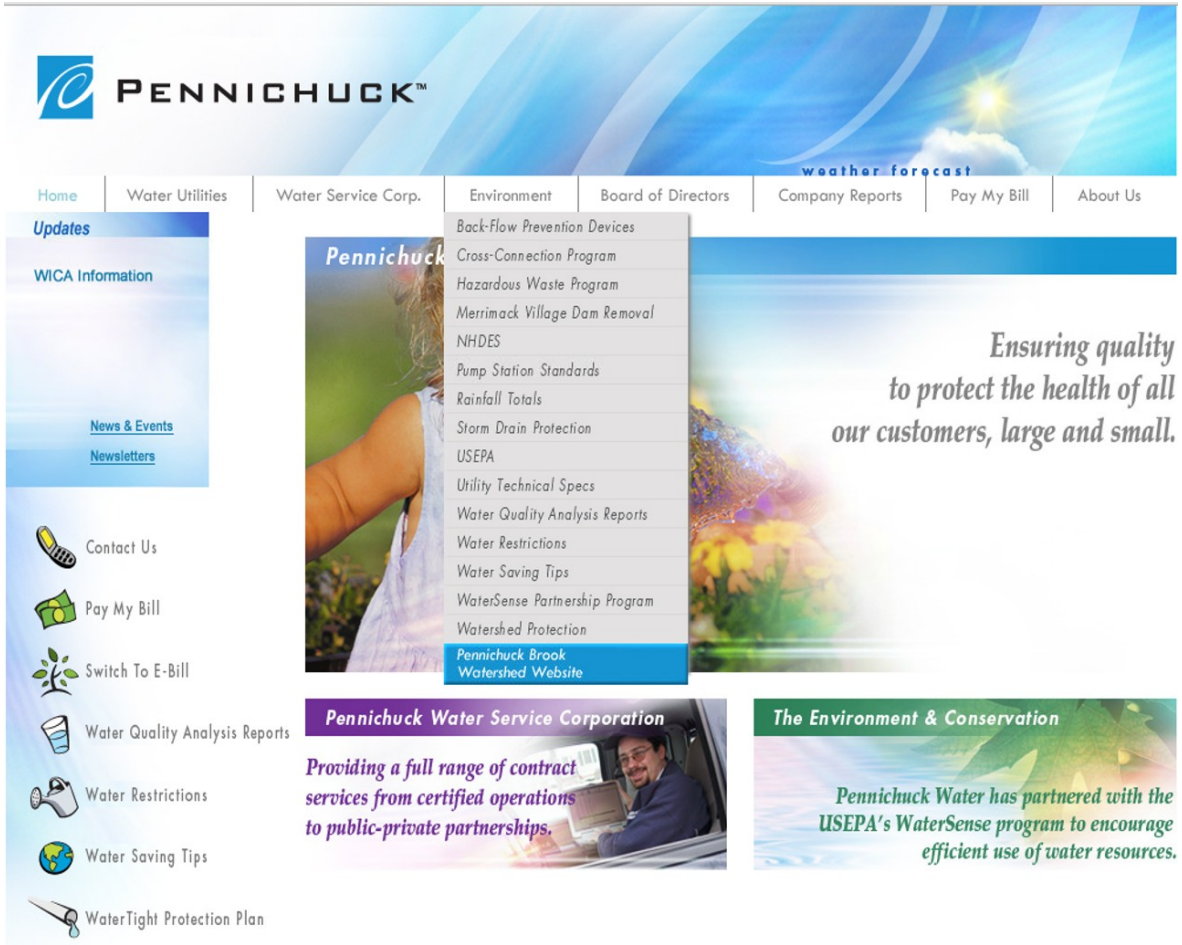


- EPA SWMM Model was used;
- Results and data are provided on PWW website;
- Interactive watershed map.

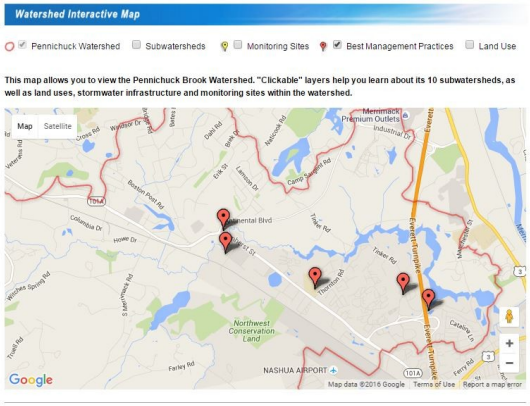


Public Outreach

- Interactive Website http://www.pennichuck.com/watershed_interactive_map.php

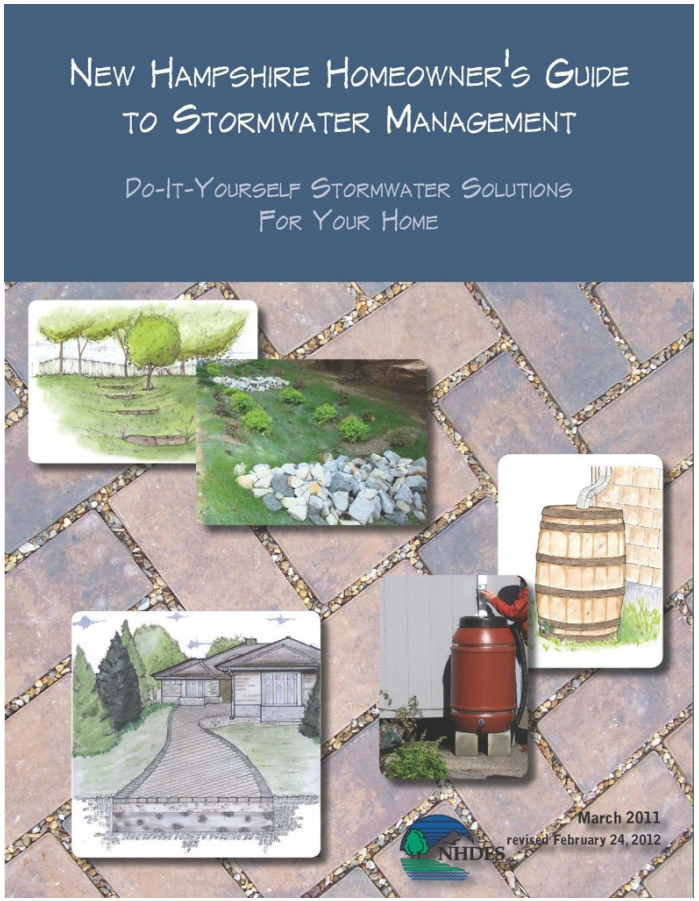


- Drinking water tools;
- Important environmental links;
- Watershed protection information;
- On-going activities;
- Interactive watershed map.



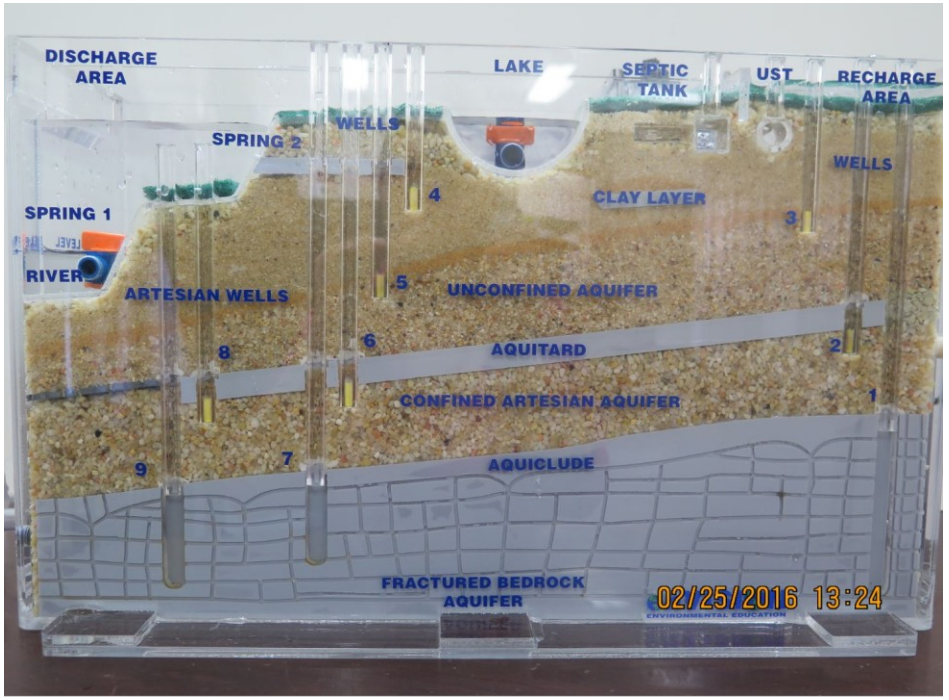
Public Outreach

- Community Outreach Program
  - Presentations to watershed communities;
  - Roof leader disconnection study;
  - Promote use of LID and Homeowner stormwater management;
  - Adoption of AOT and other state of NH standards into local bylaws.



Public Outreach

- Public School Education Program



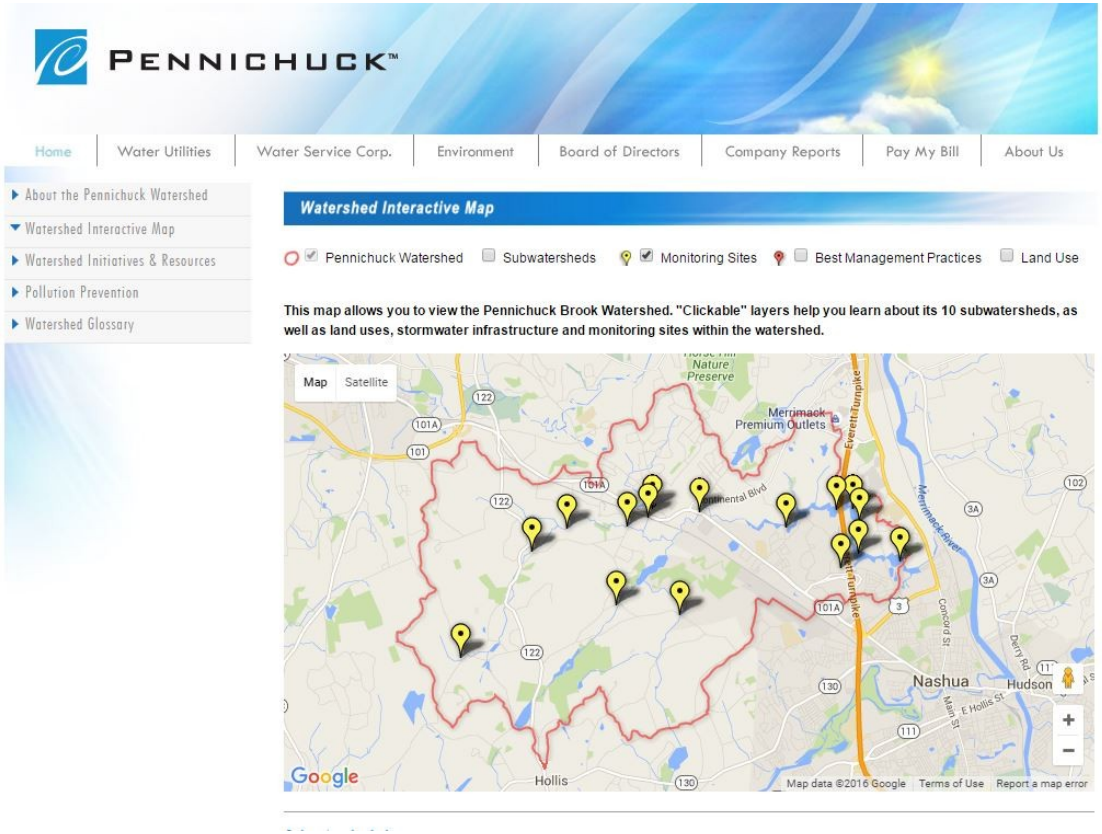
- Visit 12 elementary schools every year
- 5th Grade Classrooms (~40 plus classes are visited)
- Discuss the water cycle & watershed protection
- Poster contests

Public Outreach

- Public Education Watershed Videos
  - Four short educational videos produced.
  - Details typical stormwater pollutants and reviews water supply protection activities.
  - Will be available on PWW website.
  - Can be used to promote positive watershed behaviors.

Water Quality Monitoring

- 9 permanent tributary sampling locations.
- 5 in-pond locations
- Used to track phosphorus and other nutrients throughout the tributary systems.

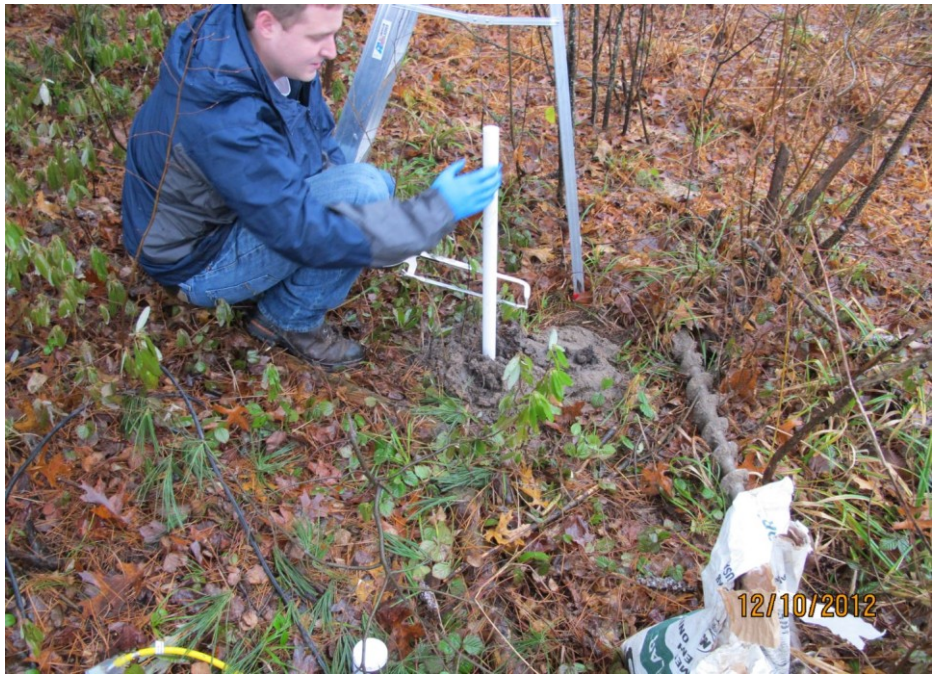


Water Quality Monitoring

- PWW has completed historical tributary sampling since circa 1998.
- A formal plan to monitor surface water flows and water quality was started in 2007.
- Stream cross sections, level loggers and staff gauges used to estimate flow weighted loading.

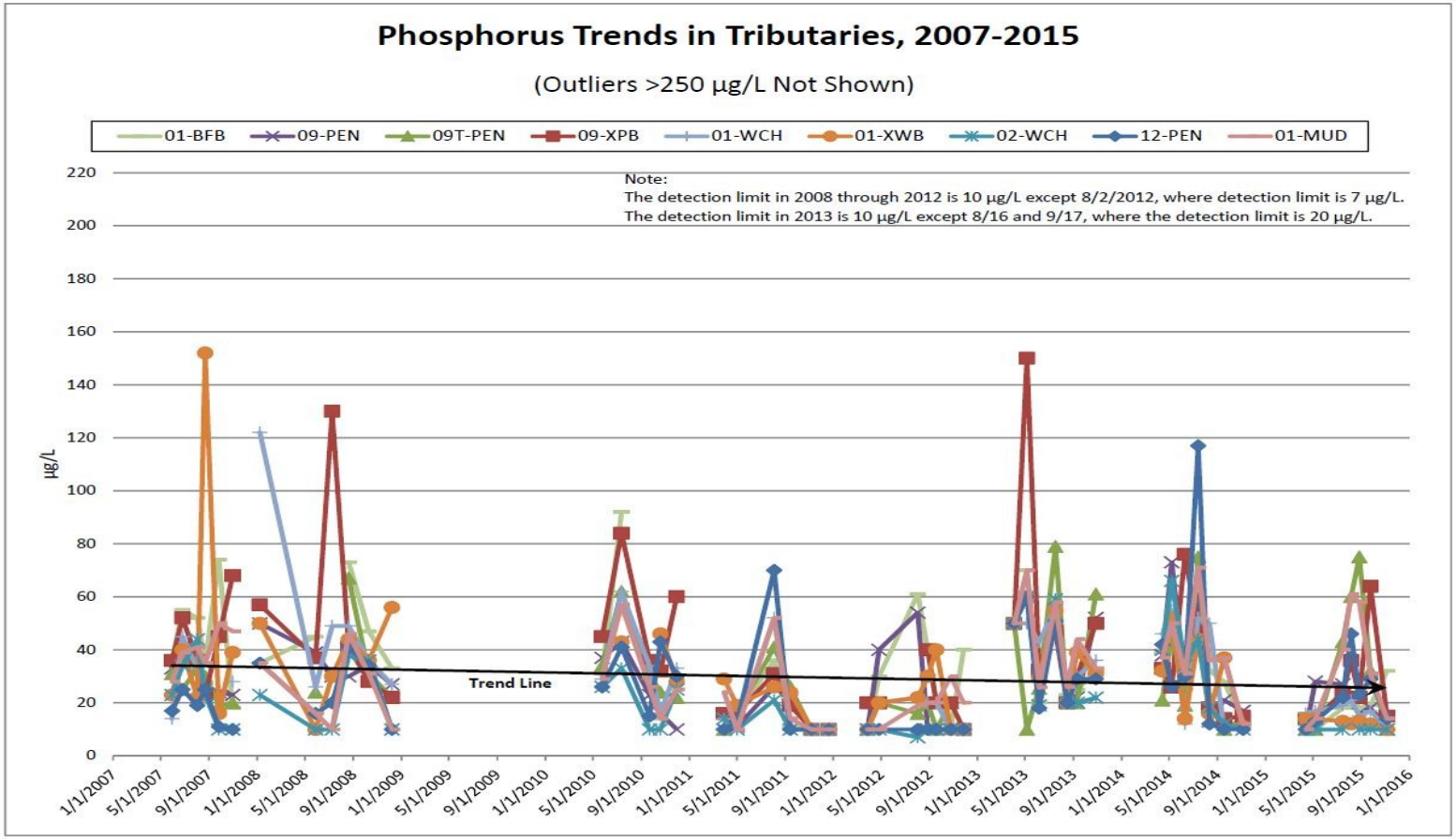
Water Quality Monitoring

- Groundwater depth measurements and water quality sampling were added in 2013



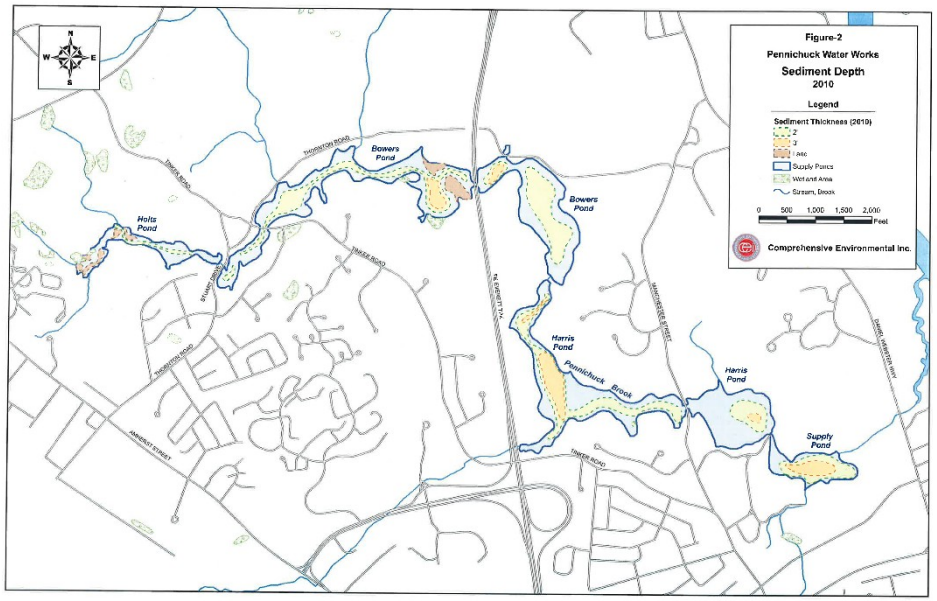
Water Quality Monitoring

- General results are summarized in an annual report and posted on the PWW website



Sediment Monitoring

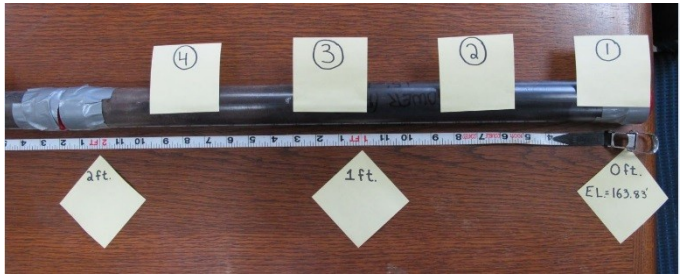
- Sediment monitoring is on-going to determine loss of storage in the supply ponds due to infill.
- Sediment depths and bathymetry was mapped in 2000 and 2010 for comparison purposes



http://www.ams-samplers.com/

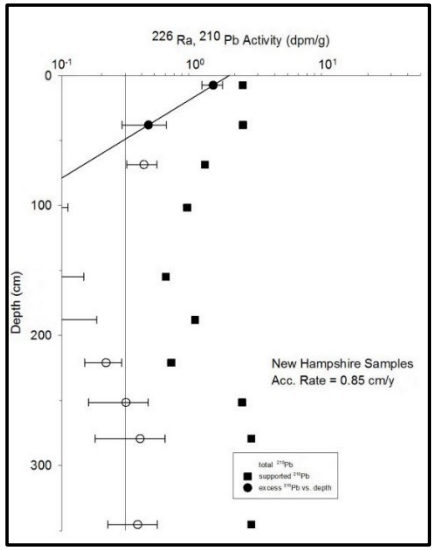
Sediment Monitoring

- In 2012 PWW completed a detailed bathymetric mapping effort in Harris and Bowers Pond using high-resolution multi-beam and sub-bottom profile surveys.
- In conjunction with the mapping effort, a more detailed sediment depth study was completed to determine:
  - Depth/Quantity of sediment
  - Type of sediment
  - Movement of sediment
  - Rate of Infill
  - Potential Storage Loss



Sediment Monitoring

- Permanent Measuring Stations
- Results
  - Radionuclide Analysis (Cs-137 & Pb-210).
  - Rate of infill could range between 0.26 cm/yr. to 0.85 cm/yr.
  - Over 100 years could result in approx. 95,000 to 109,000 cubic yards of sediment for Harris and Bowers (6% and 12% total capacity loss)



Sediment Monitoring

- PWW is currently developing one survey datum for all the ponds to estimate how much active storage is lost as a result of sediment infill.
- As part of a recent Source Water Protection Grant, PWW is planning to complete a detailed map of Holt Pond sediment accumulation and an evaluation of contributing tributaries to determine potential sources of sediment in the watershed.

BMP Implementations

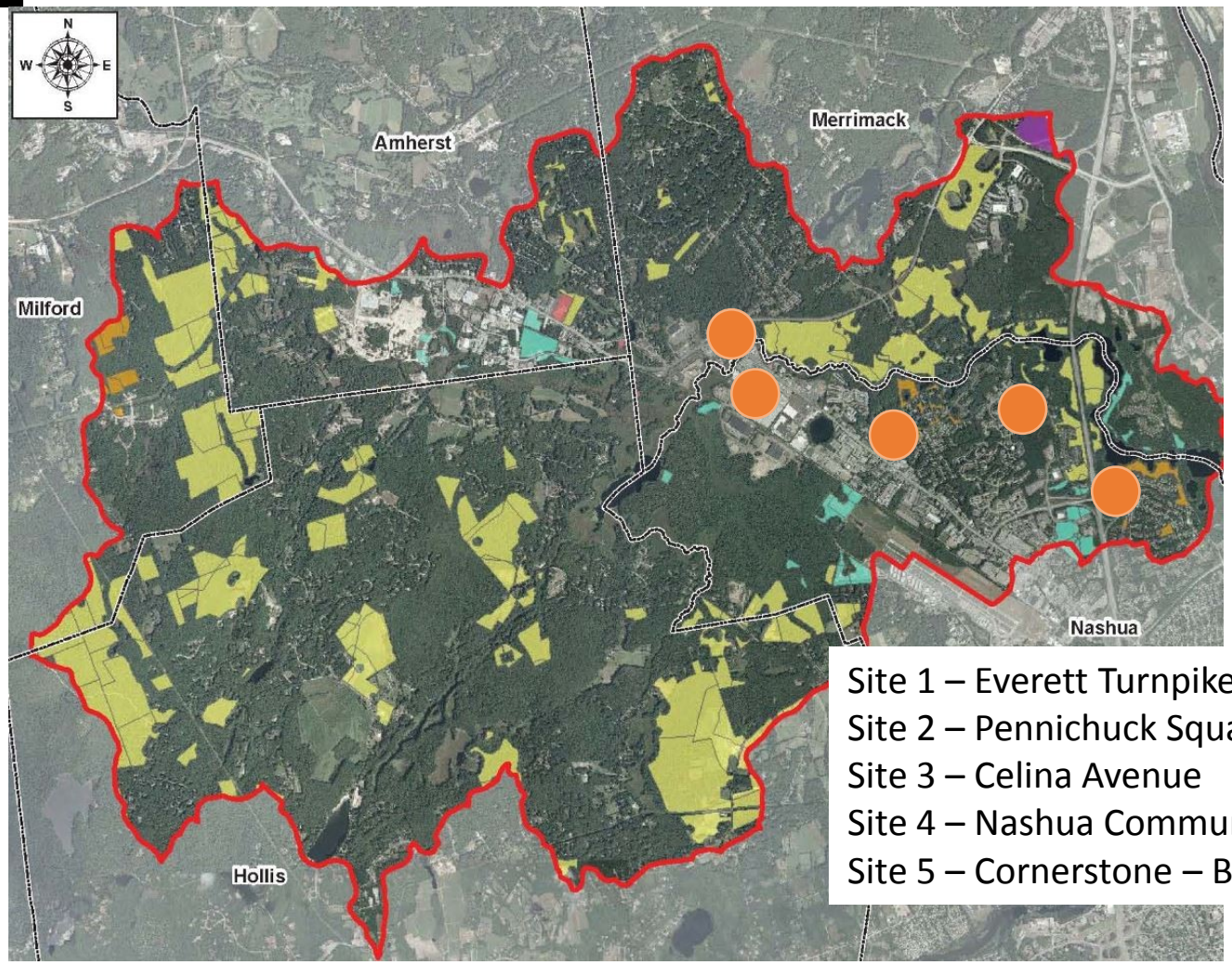
Since 2005 PWW has completed five Stormwater BMP installations throughout the watershed

BMP Goals

- ✓Spills from either local or state roads that could cause problematic pollution events (Everett Turnpike);
- ✓Sediment from road sanding and erosion that can fill in water bodies and carry pollutants into the reservoir; and
- ✓Phosphorus inflows from stormwater, which ca encourage algal blooms. Although the Pennichuck treatment plant is a state-of-the-a facility, all surface water supplies are susceptib to algae blooms and potential taste and odor issues caused by the algae blooms.

BMP Locations

PENNICHUCK

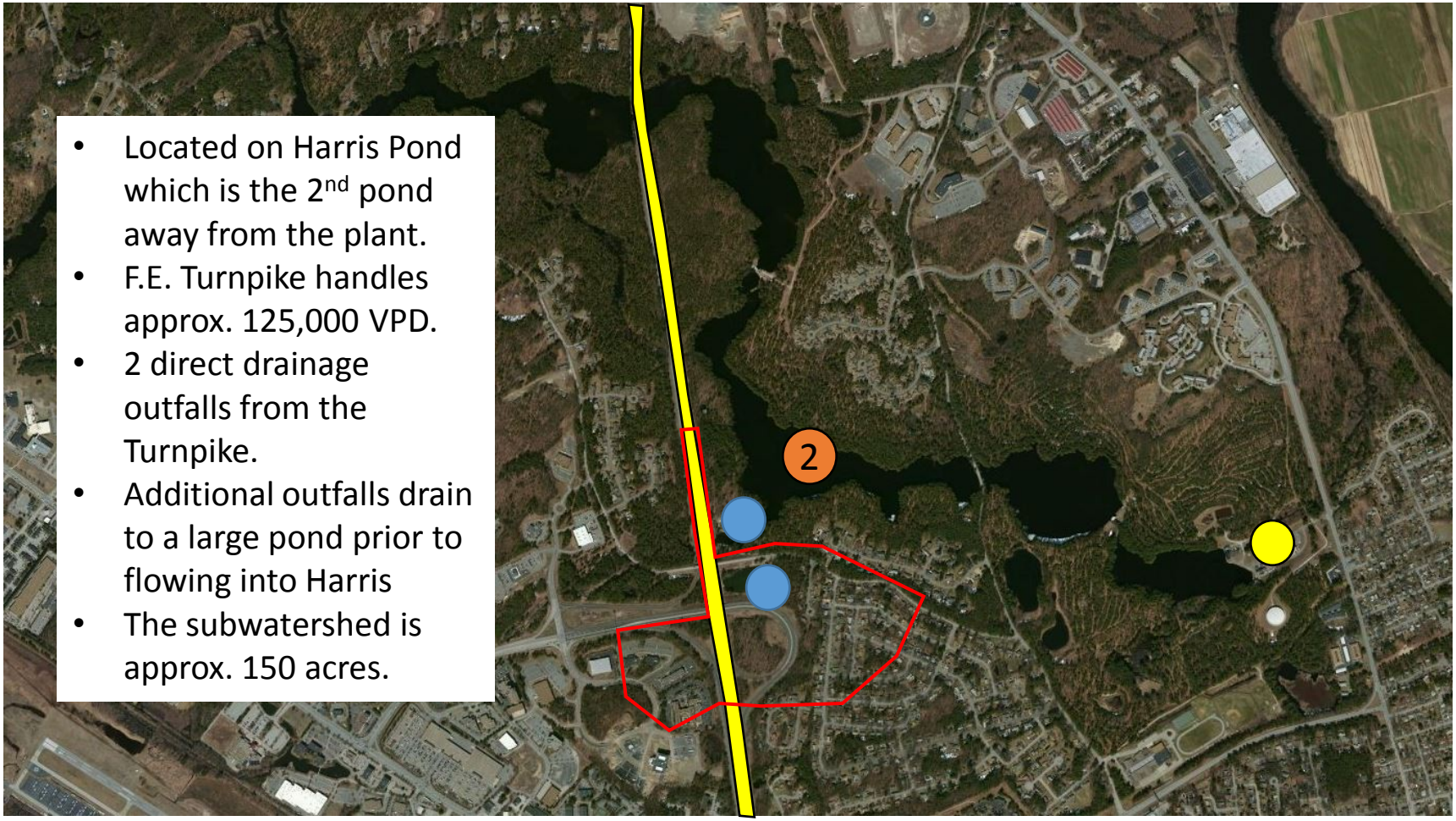


Site 1 – Everett Turnpike
Site 2 – Pennichuck Square
Site 3 – Celina Avenue
Site 4 – Nashua Community Technical College
Site 5 – Cornerstone – Boire Field

Site 1 - Location

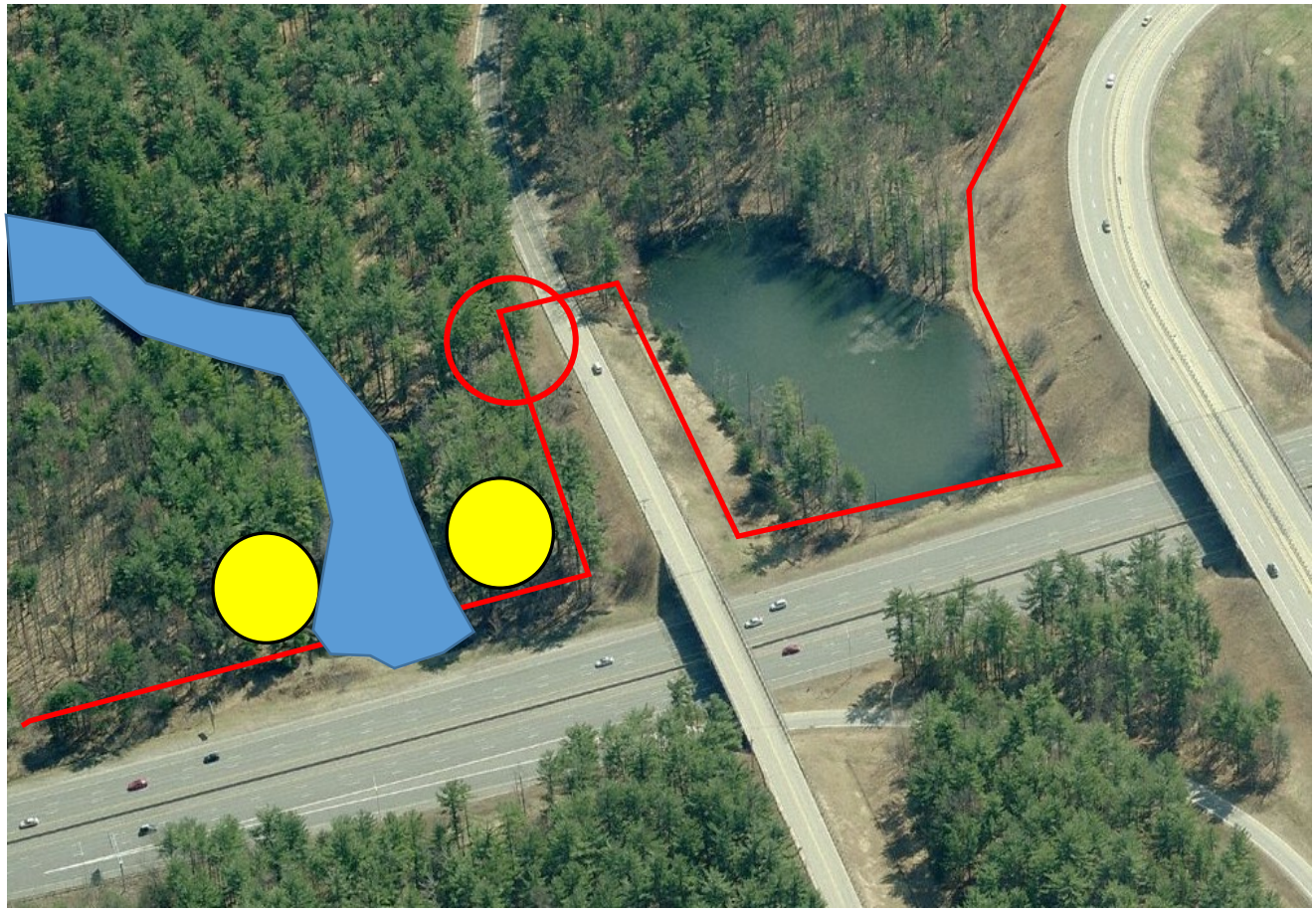
- Located in the Southern NH in City of Nashua
- Near Exit 8 off of the Everett Turnpike
- Located on land owned by Pennichuck

Site 1 - Project Location



- Located on Harris Pond which is the 2nd pond away from the plant.
- F.E. Turnpike handles approx. 125,000 VPD.
- 2 direct drainage outfalls from the Turnpike.
- Additional outfalls drain to a large pond prior to flowing into Harris
- The subwatershed is approx. 150 acres.

Site 1 - Conditions

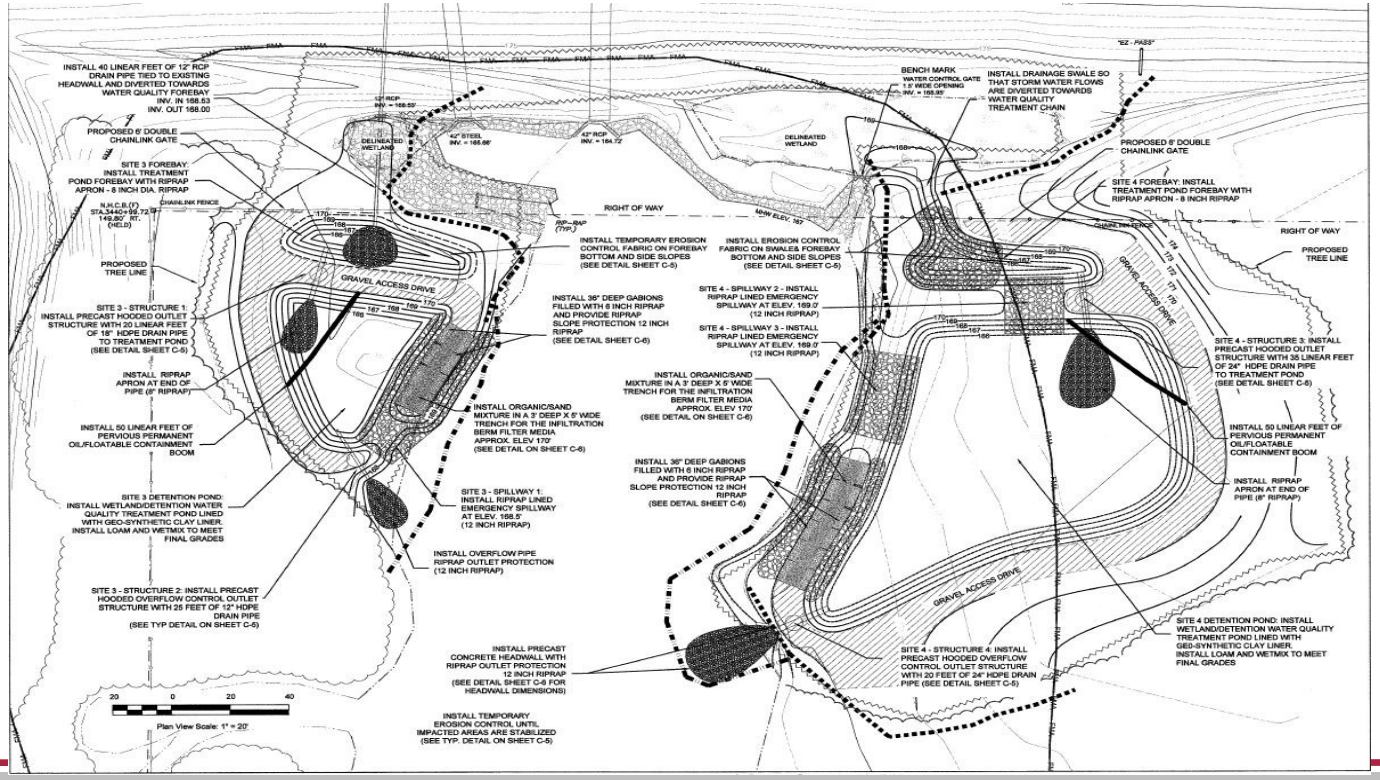


- Two sections of landlocked property where the BMPs could be located.
- Cut off by water
- Access Cut off by DOT L.A.R.O.W.

Site 1 -Proposed BMPs

Treatment

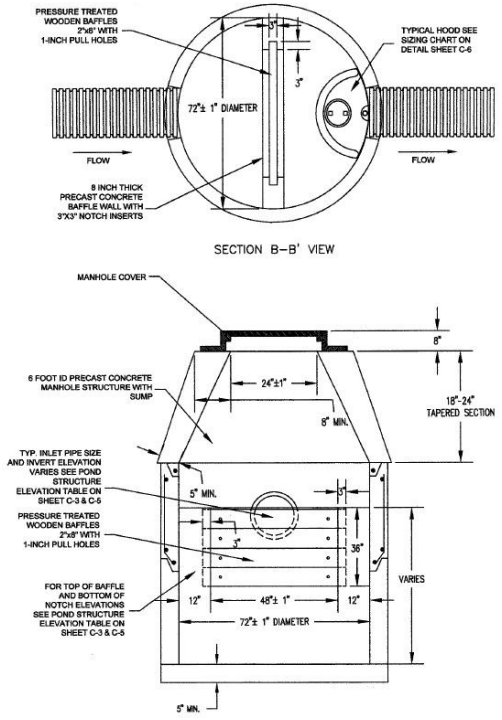
- Pretreatment with spill containment capabilities
- Treatment Wetlands
- Gravel filters for nutrient and temperature controls (future filter replacement)



Site 1 - Proposed BMPs

Accidental Spill Controls

- Special liner protected with gravel and stone to prevent puncturing during maintenance;
- BMPs always filled with water to enable floating containment;
- Large hoods over outlet piping and permanent floating booms at spillways;
- Buys time for spill response and no immediate operation required.



Site 1 - Challenges

- DOT L.A.R.O.W.
- Permits
- High Groundwater
- Topography
- Proximity to Reservoir
- Construction & Water Handling
- Future Maintenance Access

Site 1 - Construction Photos

Location 1 – Construction Sequence

Location 2 – Construction Sequence

Site 1 - Completed BMPs

Site 1 - Completed BMPs

PENNICHUCK

Additional BMPs

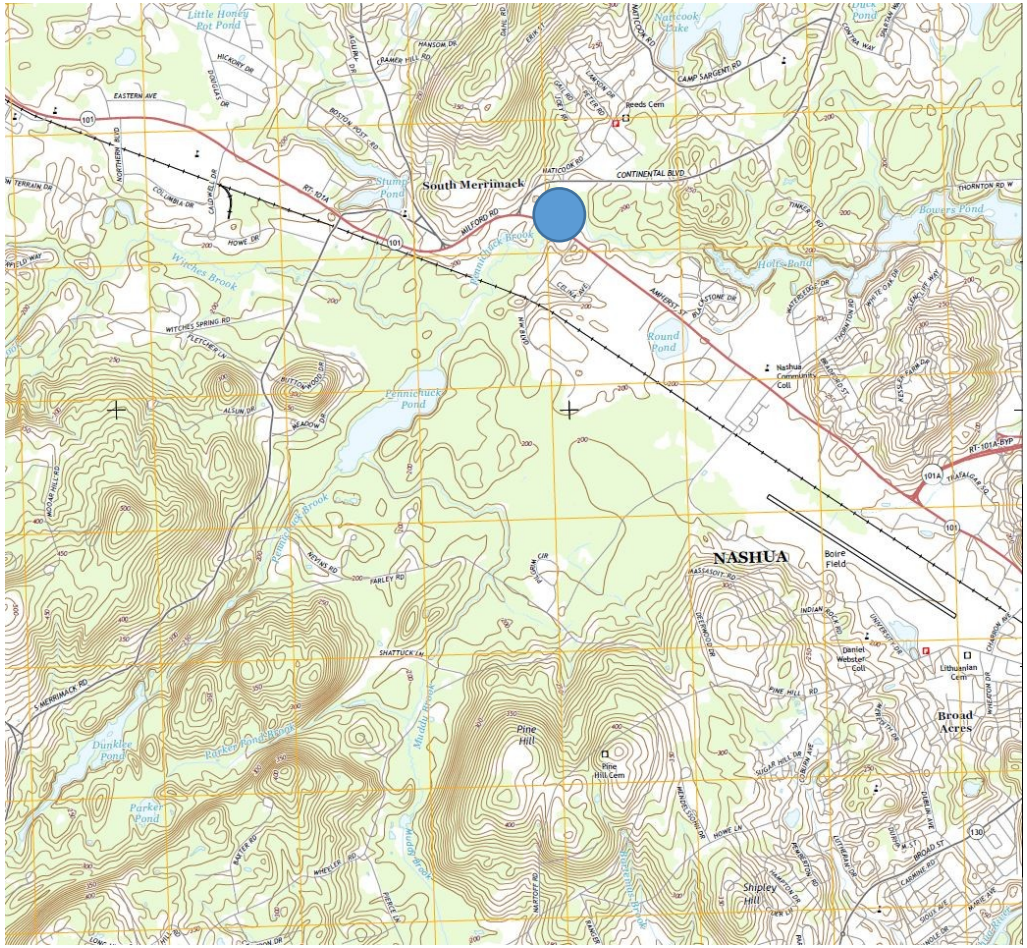
Tinker Road

- Sediment forebays for large residential area
- Outlet control structure

Site 1 - Results

- BMPs cost approx. $ 310,000.
- Completed within 3-4 months Fall 2010 & Spring 2011.
- Functioning as designed and providing protection from accidental spills.
- Plans to monitor success through maintenance tracking and sampling.

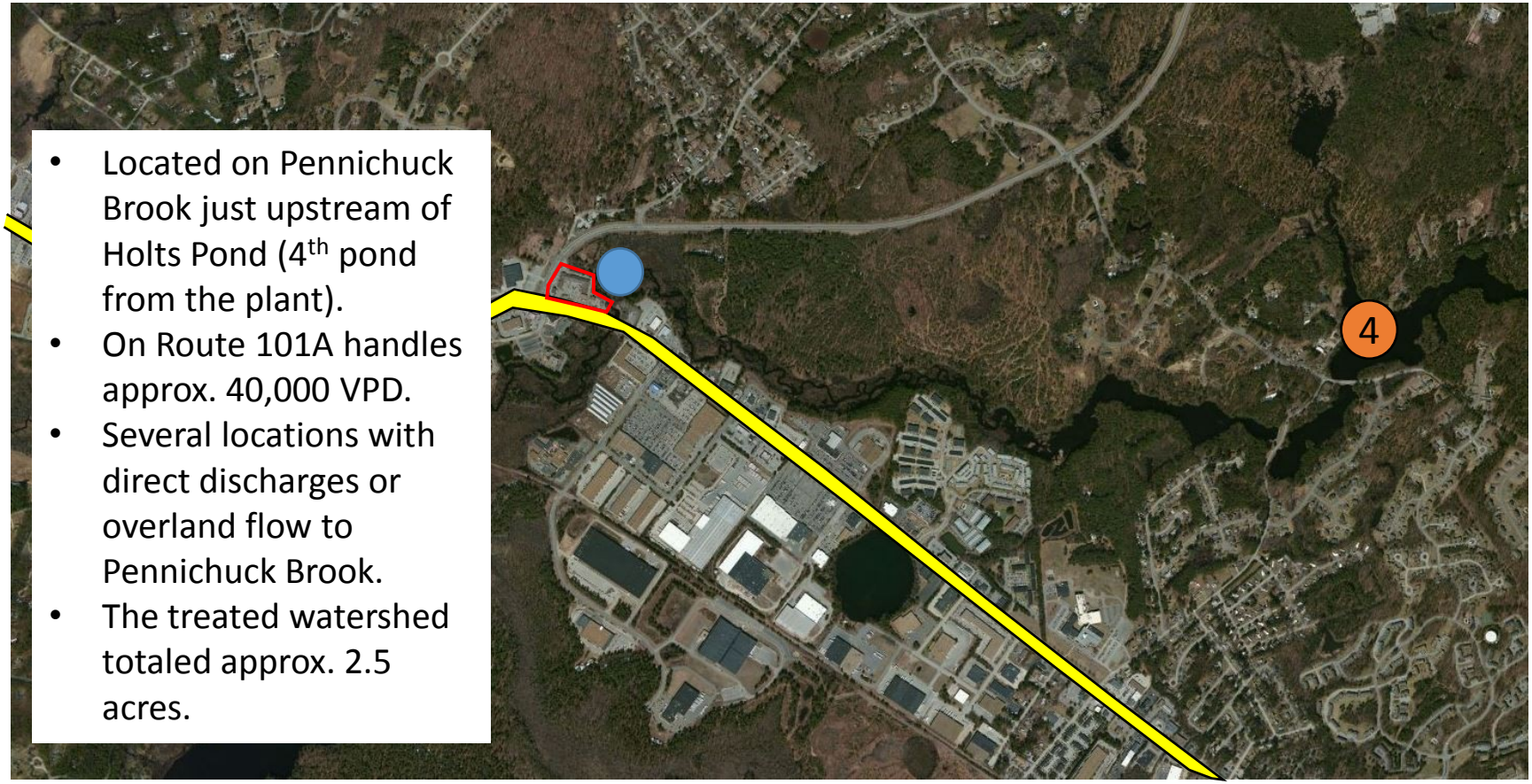
Site 2 - Location



- Located in the Southern NH near the Merrimack / Nashua border
- Intersection of Route 101A and Continental Blvd.
- Located at a commercial plaza that is privately owned called Pennichuck Square

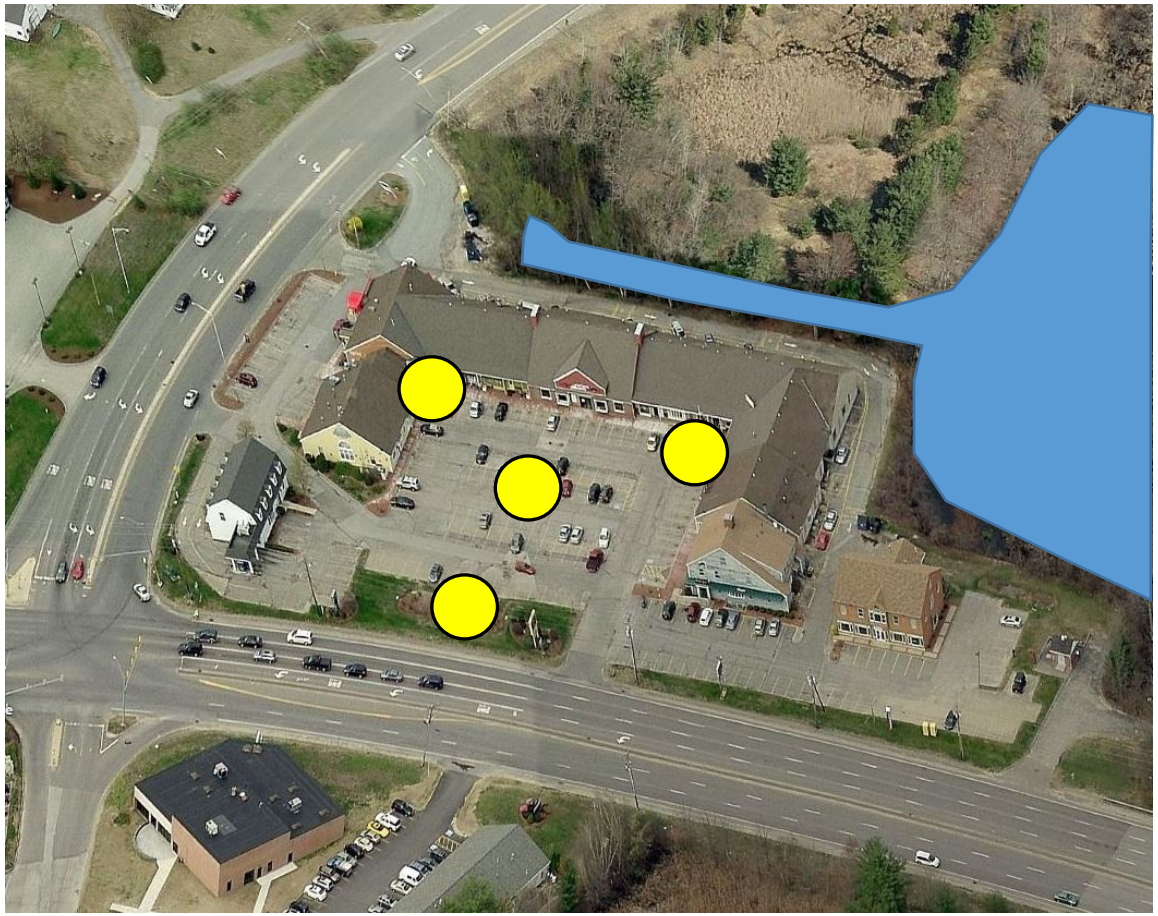
Site 2 - Project Location

PENNICHUCK



- Located on Pennichuck Brook just upstream of Holts Pond (4th pond from the plant).
- On Route 101A handles approx. 40,000 VPD.
- Several locations with direct discharges or overland flow to Pennichuck Brook.
- The treated watershed totaled approx. 2.5 acres.

Site 2 - Conditions

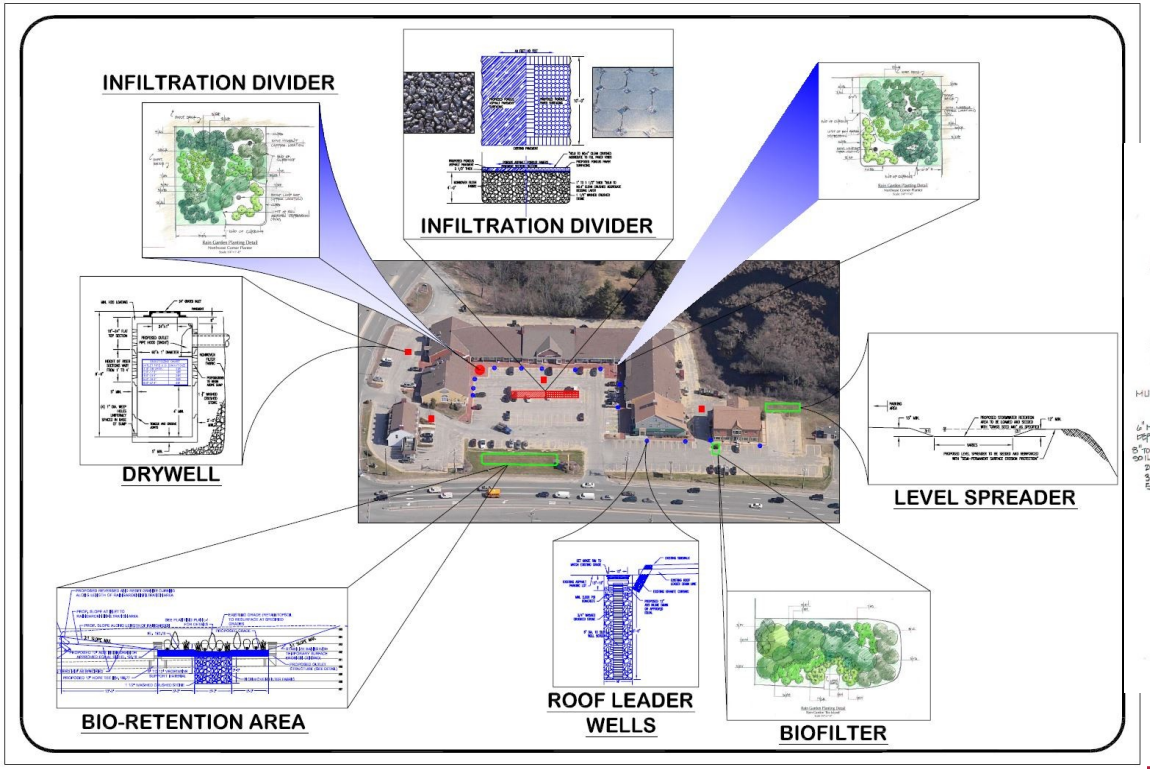


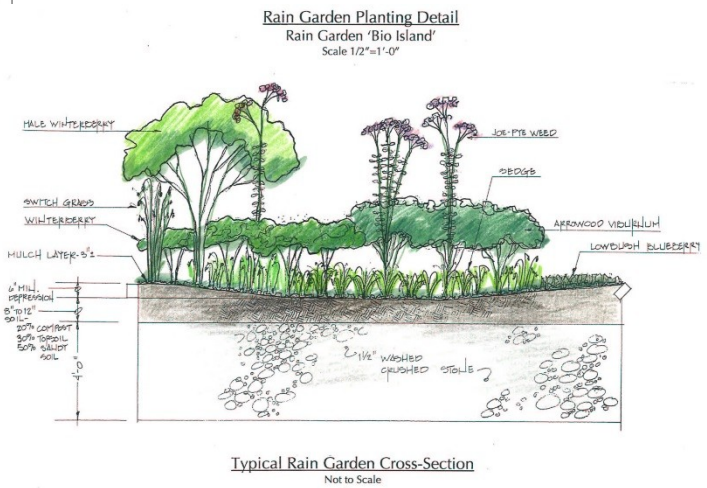
- Existing busy commercial property at intersection of Continental Blvd. & Rte. 101A
- Not owned by PWW
- Site is surrounded by wetlands associated with Pennichuck Brook
- Large impervious area that discharges into closed drainage (historic flooding)

Site 2 -Proposed BMPs

Treatment & Low Impact Design

- Bioretention Islands to treat parking lot and infiltrate roof runoff
- Porous paving materials & LCBs to infiltrate runoff and reduce flooding
- Rain Garden to filter nutrients and capture sediment





Site 2 - Challenges

- Ownership
- Utilities
- Available space
- Impacts to store owners
- Future Maintenance Responsibilities

Site 2 - Construction Photos

Bioretention Islands

Site 2 - Construction Photos

Porous Pavers & Asphalt

Site 2 - Construction Photos

Large Rain Garden

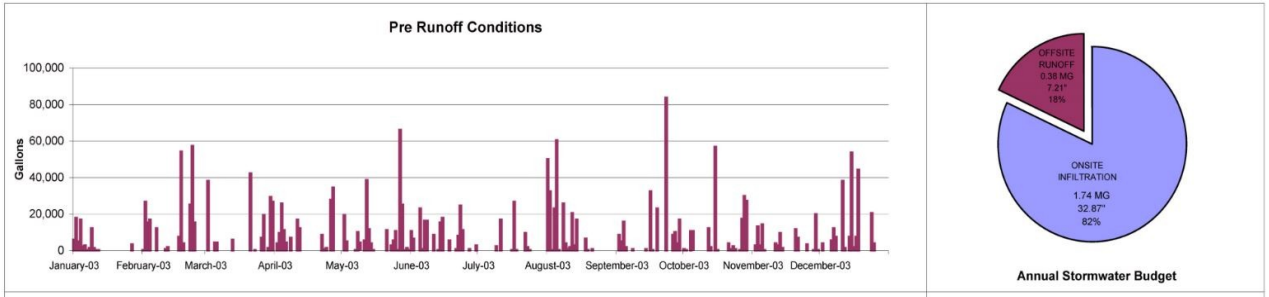
Site 2 - Completed BMPs

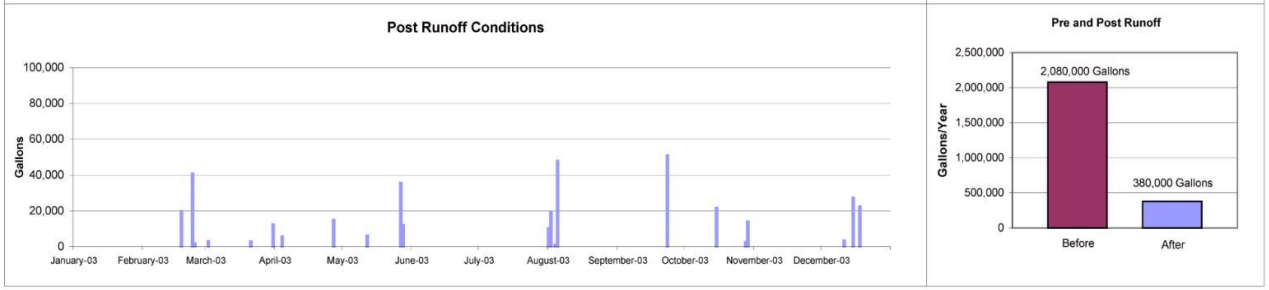
PENNICHUCK

Site 2 - Results

- BMPs cost approx. $ 150,000.
- Completed within 1-2 months during the Summer of 2005.
- LID Results – 80% reduction in runoff leaving the site

EFFECTS OF LID AT PENNICHUCK SQUARE





Notes:
1. Precipitation Data obtained from:http://www.ncdc.noaa.gov/oa/climate/climatedata.html for Manchester Airpark WMO# 743945
2. BMPs are designed to treat a combined 0.78" of runoff.
3. BMPs are assumed to empty within 72 hours. This assumption was used in the calculation for onsite infiltration.

Conclusions

Answer: It takes a lot to protect a water supply.

- Identify potential threats
- Monitor
- Public outreach
- Good communication
- Implementation of controls

It’s possible that some of the highlighted actions could be helpful in the protection of a water supply near you…….

Questions

Questions

Benjamin Lundsted, P.E.

Comprehensive Environmental, Inc.
21 Depot Street
Merrimack, NH 03054

1-800-725-2550
blundsted@ceiengineers.com

Pennichuck Website:

http://www.pennichuck.com